and Prof. Cresson continued the discussion, by reference to Tyndall's observations on the heat-absorbing capacity of aqueous vapor, furnishing, in fact, the only sound basis for explaining the variations of the daily climate.

The minutes of the Board of Officers and Members in Council were read.

Pending nominations 508, and new nominations 509 to 518 were read.

The bill of Pawson & Nicholson was referred to the Committee on Finance.

The Library Committee reported as follows:

At an adjourned meeting of the Library Committee, February 19th, 1864, the resolution offered at the stated meeting of the Society, October 2d, 1863, and referred to the Library Committee to report thereon, was considered, and on motion of Mr. Price the following resolution was offered to the Society, viz.: *Resolved*, That the Catalogue, as far as printed, be distributed to such as agree, by subscription, to take the whole volume of three parts, at the price fixed upon by the Society, payable when the second part shall be delivered. On motion the resolution of the Committee was agreed to by the Society.

The Society was then adjourned.

Stated Meeting, March 4, 1864.

Present, thirty-four members.

Dr. Wood, President, in the Chair.

Prof. Chase, a recently elected member, was introduced to the President, and took his seat.

A letter acknowledging the receipt of publications was received from the Natural History Society of Newcastle on Tyne, dated February 4th, 1864.

A letter respecting transmitted manuscripts was received from Prof. Zantedeschi, dated February 7th, 1864.

A letter requesting an exchange of publications was received from the Imperial Library at St. Petersburg, dated January 10–22, 1864. On motion, the Imperial Library was ordered to be placed on the list of correspondents.

A letter from Dr. Leidy to the Secretary, dated Philadelphia, February 23d, 1864, was read and referred to the Curators for action.

A letter from Prof. Haidinger to the Secretary, dated Vienna, February 9th, 1864, was read, inclosing a list of contributors to the Von Martius Festival Medal. On motion, the list was ordered to lie on the table, to afford members an opportunity to subscribe.

Donations for the Library were announced from Prof. Zantedeschi, the Royal Astronomical Society, the Essex Institute, the Academy of Natural Sciences at Philadelphia, Dr. B. H. Coates, Senator Wilson, and the National Observatory.

Photographic portraits of Leo Lesquereux, Isaac Lea, and Elias Durand, members, were presented for the Album.

The death of Prof. Edward Hitchcock, a member, at Amherst, Massachusetts, on the 27th ult., aged 70 years, was announced by the Secretary.

The Committee to which was referred the paper on Grave Creek Mound reported against its publication and were discharged, their report having been accepted and approved.

The report of the Board of Secretaries on the communication received from the Royal Society, was, on motion, adopted, as follows: 1. That they are prepared to furnish to the Royal Society a supplementary list of American Journals and Societies to complete their catalogue of scientific memoirs. 2. That they recommend to the Society to offer to prepare, at the expense of the Royal Society, a catalogue of papers contained in such volumes of said list as the Royal Society may indicate.

Dr. Cresson exhibited his improved magnifying and polarizing oxyhydrogen apparatus. On motion of Dr. Bache, the thanks of the Society were presented to Dr. Cresson for the

pleasure and instruction he had given to the members by this exhibition.

Mr. Lesley drew the attention of the members present to the beautiful recent microscopical investigations of Prof. Sorby into the metamorphic condition of rocks.

Mr. Chase referred to the communication which he had made at the last stated meeting, and made further remarks respecting the alleged connection between the variable rate of the earth's rotation and the mean temperature of given parts of its surface.

Mr. Colburn's inquiry into the nature of heat suggests some interesting speculations concerning other effects of rotation than those that can be measured by the barometer. Recognizing the impossibility that the sun should warm the whole solar system, as a simply incandescent body,—the improbability that its heat should result from continuous combustion, and the probable approximate uniformity of temperature in the upper regions of the atmosphere, in summer and in winter, by day and by night, Mr. Colburn looks for the principal sources of heat in the earth itself. He supposes, 1, that the solar attraction tends to draw into closer proximity the particles of air on the heated side, and to separate them on the night-side of the earth, thus producing heat of compression, and cold of expansion: 2, that the change of eastward velocity from 69,000 miles per hour at midnight, to 67,000 miles at noon, (*sic*) necessarily produces a conversion of motion into heat, and of heat into motion: and 3, that if the earth is moving in a resisting medium, by which it is so retarded that it approaches the sun at the rate of 1,000,000 miles in 3,000,000 years, its "lift" involves the annual abstraction of a heat-force equivalent to 752,665,108,390,000 horse-power!

The third hypothesis has been often broached; the indications of a resisting ether, which, as we have seen, are furnished by the hourly barometric means, may, perhaps, yield the data for its final verification or rejection. The supposed separating effect of the sun's action in the most remote portions of the atmosphere, is so problematical that it seems hardly deserving of any consideration, and even if it existed, it is difficult to understand how it could produce a difference of more than a fraction of a degree in the range of the thermometer. The alternate acceleration and retardation of orbital velocity, can produce no *accumulation* of heat to supply any

loss that may arise from radiation into space, but it must modify the *distribution* of heat throughout the day in a manner that may be readily calculated. The available data are not sufficient to furnish us with complete results, but they give curious approximations that seem to open a wide field for profitable investigation.

"Sir John Herschell finds the direct heating effect of a vertical sun at the sea level to be competent to melt .00754 of an inch of ice per minute, while according to M. Pouillet, the quantity is .00703 of an inch."* Taking the mean of these two estimates (.00728 in.), multiplying by the latent heat of water (142.6° F.), and dividing by the number of cubic inches in 1 lb. of water (28), we obtain $\frac{.00728 \times 142.6}{28} = .037076$ units of heat received per minute on each square inch of the earth's surface that is exposed to a vertical sun. The weight of the aerial column being 15 lb., and its ratio of specific heat 25, the maximum effect of the direct solar rays is sufficient to heat the whole atmosphere $\frac{.0371}{15 \times .25}$ per minute, or 7.12° F. in 12 hours.

Now, in consequence of the earth's rotation, the difference of atmospheric "lift" between noon and midnight, is 182,336 ft. per minute. The average difference for the twelve hours, is one-half as great. "Rapid rotation, without friction or resistance, cannot in itself alone be regarded as a cause of light and heat;"† but we have found in our barometric investigations, that the ratio of the half-daily velocity of rotation to that which would be conferred by twelve hours' action of terrestrial gravity, is .00109, which may be regarded as the modulus of heat-producing resistance. If we multiply the average difference of lift by the weight of the atmosphere, and by the effective resistance, dividing the product by the ratio of specific atmospheric heat, and the number of foot-pounds raised by a unit of heat, we obtain $\frac{91168 \times 15 \times .00109}{770 \times .25} = 7.74°$ F. as the amount of heat communicated to the air by rotation between midnight and noon, and abstracted between noon and midnight.

The theoretical barometric lift is, as we have seen, .00219 of the entire weight of the atmosphere. Estimating the height of the aerial column when reduced to uniform surface density, at 24,000

* Tyndal, Heat considered as a Mode of Motion. N. Y. edit. p. 431.

† Dr. J. R. Mayer.

feet, the heat-producing disturbance that is indicated by the barometer, is represented by a lift of 15 lb. on each square inch to a height of $.00219 \times 24000$ ft. The quarter-daily disturbance from this cause is, therefore, $\frac{24000 \times 15 \times .00219}{770 \times .25} = 4.1°$ F.

It is more than likely that each of these results will require important modifications when the entire influence of the several conditions of the problem is better understood. I have thought it proper to present them in their present crudity, in order to show the true points of departure, and to prepare the way for some further considerations.

Whatever other heat-disturbing causes there may be, there can be little doubt that the three we have just been considering are the most important. Dividing the astronomical day into four quadrants, and representing the solar effect by S., rotation by R., and barometric by B., it will be readily seen that the several positive and negative influences must be distributed as follows:

	S.	R.	B.
From 0h. to 6h.	+	—	—
" 6h. to 12h.	—	—	+
" 12h. to 18h.	—	+	—
" 18h. to 0h.	+	+	+

The tables of average temperature at any given place would therefore furnish us with four equations for determining the value of each of the disturbing elements, provided those that are unknown were so insignificant as to be safely neglected. The effects of these unknown disturbances are confined within certain limits that can be pretty satisfactorily determined.

Our discussion of the barometric fluctuations demonstrated a tendency of inertia to retard the effects of rotation, so that the mean daily altitudes are found nearer to 1h., 7h., 13h., and 19h., than to 0h., 6h., 12h., and 18h. A like tendency is discernible in the thermometer.

There are three, and only three, quadrantal divisions of the day, commencing respectively at 0h., at 1h., and at 2h., for which we could obtain approximate positive values of S., R., and B. The maximum solar effect is deduced from the first, and the minimum from the third of these divisions; while the maximum rotative and barometric effects are exhibited in the third, and the minimum in the first division.

The nearest average temperatures are found in the third division, as is shown below.

Average of temperature at 2h., 8h., 14h., and 20h., and of the entire day.

Station.	Mean of the four hours.	Daily mean.
At Girard College, . .	52°.1	52°.1
At St. Helena, . . .	61°.65	61°.69

The following table presents all the co-ordinate positive values of S., R., and B., that can be obtained from the Girard College and St. Helena means.

Station.	Dividing at								
	0, 6, 12, 18h.			1, 7, 13, 19h.			2, 8, 14, 20h.		
	S.	R.	B.	S.	R.	B.	S.	R.	B.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Girard College, . .	45.92	41.32	12.76	31.3	49.5	19.2	13 8	63.2	23
St. Helena, ...	25.97	42.96	31.07	15.8	46.7	37.5	5.6	56.6	37.8

The percentages of the calculated values correspond very nearly with the means of the earliest Girard College and St. Helena values.

	Calculated values.	Percentage.	Mean Percentage.	Limits.	
S., . . .	7°.12	37.6	35.95	5.6	45.92
R., . . .	7°.74	40.8	42.14	40.8	63.2
B., . . .	4°.1	21.6	21.91	12.76	37.8

It may be inferred from this comparison, that the rotation element of daily heat is least affected, and the solar element most affected by extraneous causes, (of which moisture is probably the chief); that the first division gives the best, and the third division the poorest results; that the proportion of thermometric variation which is attributable to rotation is between .4 and .5 of the average total daily variation, and that the most difficult element to determine satisfactorily is S., which is modified by many local disturbing influ-

ences, such as the nature of the soil, amount of vapor, clouds, altitude of the sun, &c. &c.

Pending nominations, Nos. 508 to 518, and new nomination No. 519, were read.

On motion of Mr. Peale the following resolution was considered and adopted: *Resolved*, That the Curators be authorized to make such selection as they may deem proper, of articles from the Cabinet of the Society, and place them at the disposal of the Chairman of the Committee on Curiosities, Relics, and Autographs, for the Sanitary Commission, as a loan for exhibition during the ensuing fair.

And the Society was adjourned.

Stated Meeting, March 18, 1864.

Present, twenty-three members.

Judge Sharswood, Vice-President, in the Chair.

Prof. William D. Whitney, a recently elected member, was introduced to the presiding officer and took his seat.

Letters announcing the transmission of publications were received from the Royal Academy at Lisbon, dated November 25th, 1863, and from the Engineer Department at Washington, March 17th, 1864.

Donations for the Library were announced from the Royal Academy at Lisbon, the Royal Society at Edinburgh, the British Meteorological Society, the Annales des Mines, the Boston N. H. Society, the Franklin Institute, Messrs. Blanchard and Lea, and the Engineer Department of the United States.

On motion of Mr. Barnes, Dr. Goodwin was appointed to prepare an obituary notice of the late President Hitchcock.

The Secretary read a letter from Prof. Wilson, of Toronto, offering for sale a new copy of the "Birds of Australia," costing originally £150, and never yet taken from its case.